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TITLE: POLARIZING LIGHT SOURCE DEVICE, AND PROJECTION-TYPE LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME

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Amendments: There are no amendments to this patent.

[note: All names, addresses, company names, and brand names are translated in the most common manner. Japanese language does not have singular or plural words unless otherwise specified with numeral prefix or general plurality suffix. translator's note]

DETAILED EXPLANATION OF THE INVENTION

[Field of industrial application]

This invention relates to a projection type liquid crystal display device that enlarges and displays projected image that is input to a liquid crystal panel; or a polarizing light source device that utilizes projection type liquid crystal display device.

[Prior art]

As illustrated in Figure 2, conventional projection type liquid crystal display device mainly consists of a light source device (201), a light valve comprising polarization panels (202), (205), and a liquid crystal panel (204), and a projection lens (206); and nonpolarized light (207) from light source device is directly polarized at polarization panel (202) and enters liquid crystal panel (204), and is detected with the polarization panel (205) and becomes luminous flux including projected image information; and this is enlarged and projected by the projection lens (206). As explained above, according to the conventional method that takes out linear polarized lights from lights of light source is generally conducted by taking out linear polarized lights with high polarization degree by entering nonpolarized lights from the light source device directly into a polarization plate.

[Subjects solved by this invention]

According to said prior art, when quantity of light is increased in order to brighten a display screen, temperature of polarization panel and a liquid crystal panel that is arranged nearby increases significantly; and therefore, performance degradation of polarization panel and characteristics changes of liquid crystal panel tend to occur. In order to prevent this, as shown with a cooling fan (203) in Figure 2, problem point of prior art is as such that a high capacity cooling is required. In addition, it also shows a problem point that of the two linear polarized lights which are in mutually in orthogonal relationship and are included in lights of light source , one of them is discarded through an absorption by the polarization panel to show a very poor efficiency. This invention is designed to solve these problem points; and its purpose is to offer a projection type liquid crystal display device that provides easy cooling of liquid crystal light valve, and above all, it provides a bright display screen with high utilization efficiency of lights of light source.

[Actions]

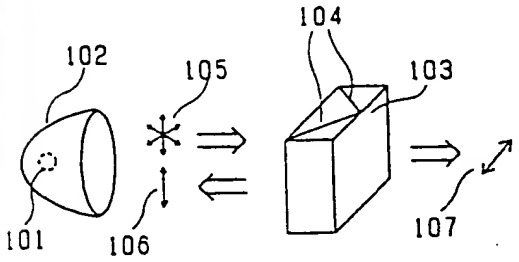
According to above-explained constitution of this invention, nonpolarized lights which are discharged from a light source device comprising a light source lamp and parabolic reflector enters dielectric multi-layer film within a polarized light separator, and is separated into two linear polarized lights showing mutually orthogonal relationship; and the one of such is utilized as it is. Furthermore, the other polarized light is reflected toward light source side; and after it is reflected at parabolic reflector, it is converged on a light source lamp. When surface of light emitting tube of light source lamp is treated in a frost form with concaves and convex ( ), polarized lights which are converged and are scattered become nonpolarized lights. And therefore, these nonpolarized lights are again reflected at the parabolic reflector in the same manner as the first nonpolarized lights which are discharged, and become almost parallel luminous flux, and enter polarized light separator and are separated as polarized lights in mutual orthogonal relationship. In addition, when a surface of light emitting tube of light source lamp happens to be smooth , and degree of polarization of converged lights which are transmitted happens to show hardly any changes, it is recommended to install a 1/4 wavelength panel between light source device and polarized light separator. In this case, one of the polarized light that is reflected from a dielectric multi-layer films within said polarized light separator passes through 1/4 wavelength panel and becomes circularly polarized light, and moves toward light source device side, and is reflected at parabolic reflector, and returns to the light source lamp. Furthermore, because this circularly polarized light becomes polarized light that is orthogonal to polarized light direction of the time when is reflected at polarized light separator for the first time after it is reflected at parabolic reflector again in the same manner as light source light, and then passes through 1/4 wavelength panel once more, it passes through the polarized light separator. And therefore, almost all lights of light source are converted to linear polarized lights at the end.

reflected at parabolic reflector (102) and becomes reversal circularly polarized light (308) and returns to the light source lamp. As light emitting tube of light source lamp (101) is made of a clear glass material, circularly polarized light (308) passes through light source lamp while retaining its polarization characteristics as they are. Then, the circularly polarized light (308) that exits light source lamp (101) again is reflected at parabolic reflector (102), and again becomes reversal circularly polarized light (309). Then, it passes through 1/4 wavelength panel (301), and becomes linear polarized light (310); however, as the main sectional planes of this 1/4 wavelength panel (301) and 1/4 wavelength panel (302) are mutually in orthogonal relationship, linear polarized light (310) is the p-polarized light to the dielectric multi-layer films, and it passes through said polarized light separator. And therefore, almost all the nonpolarized lights (304) which enter polarized light separator are converted to linear polarized lights.

Figure 4 illustrates a constitutional plane view of projection type liquid crystal display device that is constructed by using this invention's polarizing light source device. Almost all nonpolarized lights (408) from a light source device comprising light source lamp (101) and parabolic reflector (102) are converted to linear polarized lights by 1/4 wavelength panel (401) and polarized light separator (402). Although 6 dielectric multi-layer films are used in order to reduce the thickness of polarized light separator in this polarizing light source device, it is of the same principles as shown in the Figure 3 that allows transmission of p-polarized light and reflection of s-polarized light. The linear polarized lights (409) discharged form polarizing light source device show angle dependence to the polarized light separator (402) and nonpolarized lights from the light source device are not the perfect parallel lights; and therefore, that degree of polarization remains insufficient to enter the liquid crystal panel (404), and show reduced contrast ratio of display screen as they are. And therefore, they are passed through polarization panel (403) to set to linear polarized lights with high degree of polarization. The luminous flux that enters this polarization panel (403) hardly includes s-polarized light varying from the nonpolarized lights (207) which enter the polarization panel (202) of the case of conventional projection type liquid crystal display device shown in the Figure 2; and therefore, polarization characteristics of this polarization panel (403) show somewhat better degree of polarization of transmitted lights even though they may be inferior to the polarization characteristics of polarization panel (202) of conventional case. And therefore, as it is possible to utilize a polarization panel with poor polarization characteristics, that is to say, the one that shows high overall

Figure 4 illustrates a constitutional plane view of projection type liquid crystal display device that is constructed by using this invention's polarizing light source device.

101... light source lamp
102... parabolic reflector
103... prism
104... dielectric multi-layer film
105... nonpolarized light
107... linear polarized light
202... polarization panel
204... liquid crystal panel
206... projection lens
301... 1/4 wavelength panel
303... polarized light separator
307... circularly polarized light
407... screen



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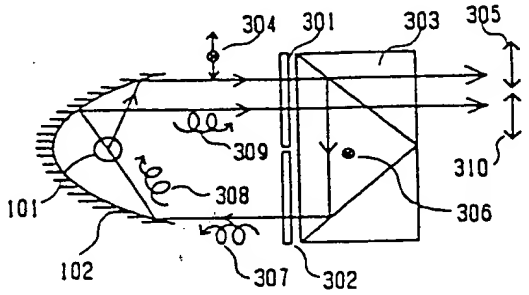

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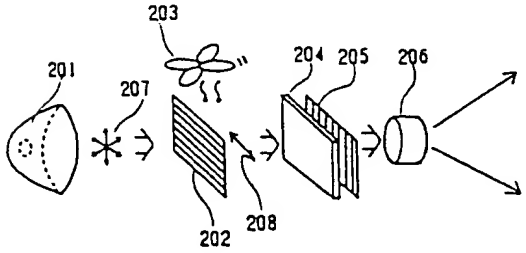

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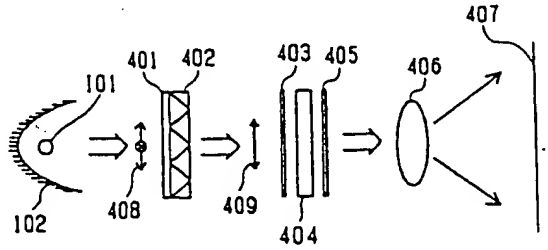

第4図

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